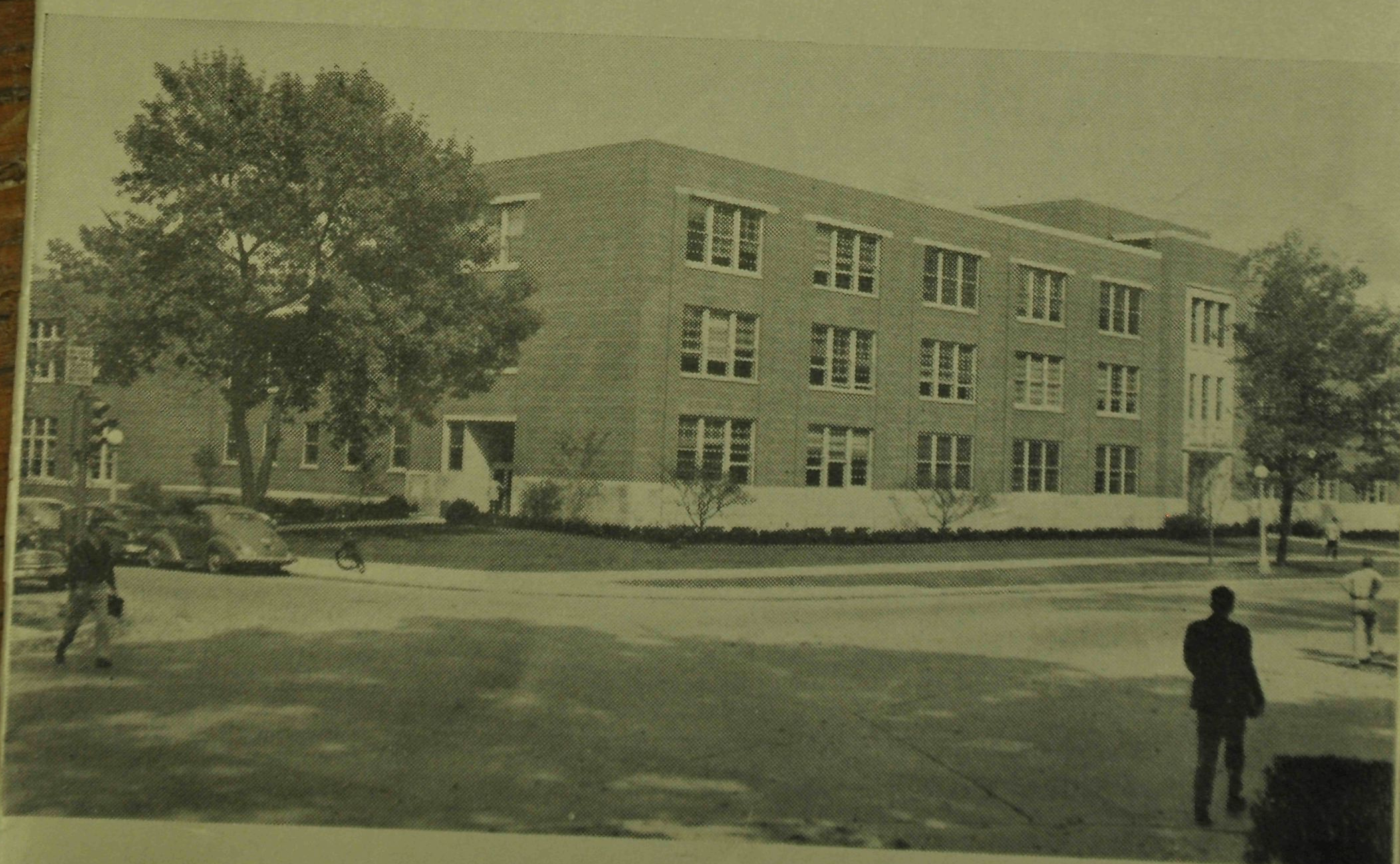
Mechanical Engineering Facilities and Equipment



UNIVERSITY OF ILLINOIS

DEVELOPMENT OF FACILITIES

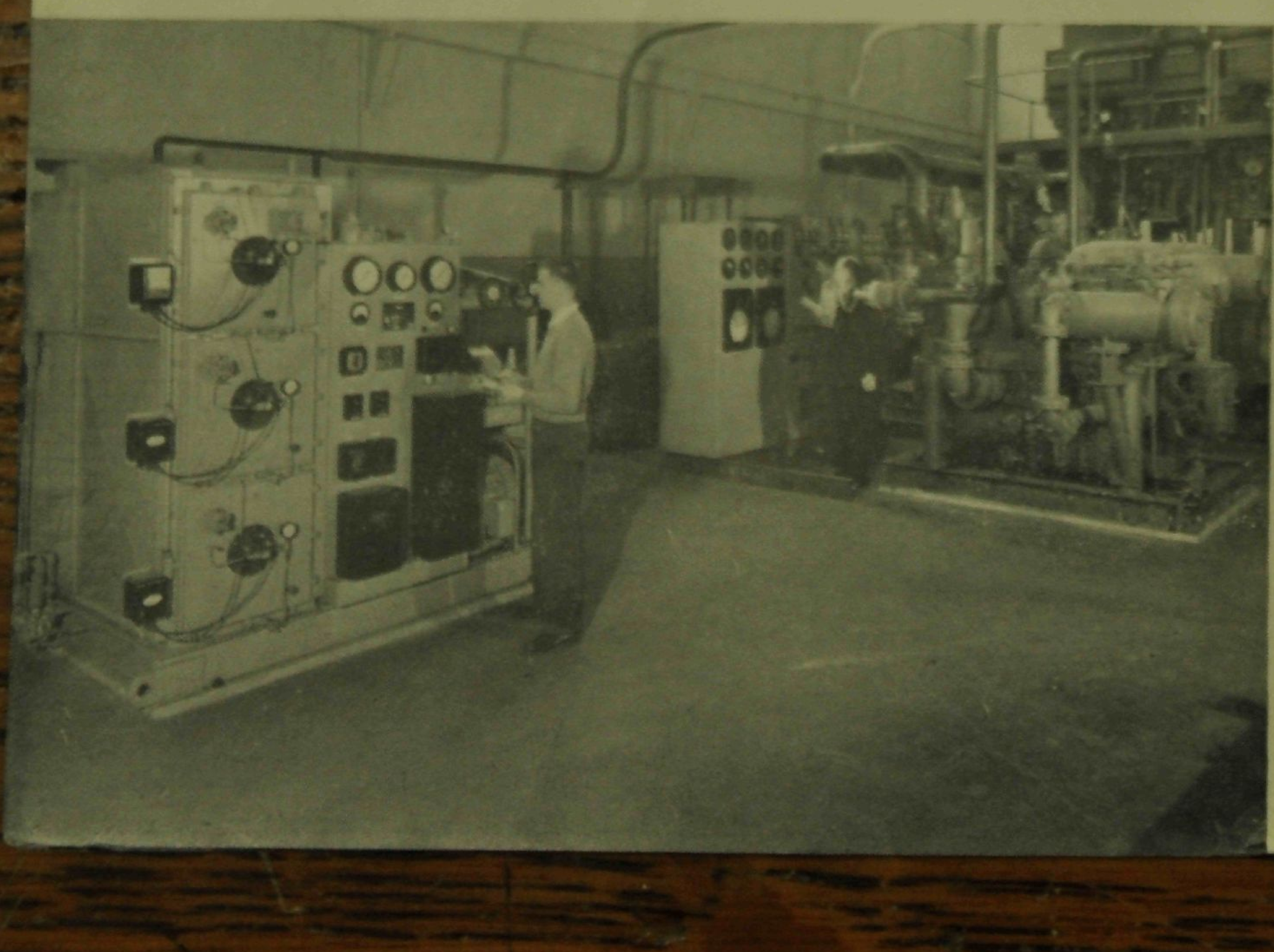
FORMATIVE YEARS 1867-1895

The Department of Mechanical Engineering was established in 1867 as a school of Mechanical Science and Art in the Polytechnic Department. It is the oldest department in the College of Engineering and started operations in 1870 at which time S. W. Robinson was appointed as Professor of Mechanical Science and Engineering. Immediately after the appointment of Professor Robinson, the Board of Trustees provided $2,000 for equipping a shop to give students practical instruction in the handling and machining of metals.

The lower story of a wooden building, 24 feet by 30 feet, that had been used as a mule stable and carpenter shop was assigned as a machine shop. The mules were driven out and the machine shop was set up. It was in this shop that Professor Robinson and his students constructed a 10-horsepower steam engine which is now exhibited as a museum piece in the Mechanical Engineering Laboratory.

In 1871 the legislature appropriated $25,000 for a two-story brick and stone structure, 88 feet by 126 feet, to be used as a Mechanical Engineering Building and Drill Hall. The Department occupied this building for shop practice. When University Hall was constructed in 1873, the Department occupied offices, recitation rooms and drafting rooms in the building and carried on all engineering work there except shop practice.

Unit Power Plant



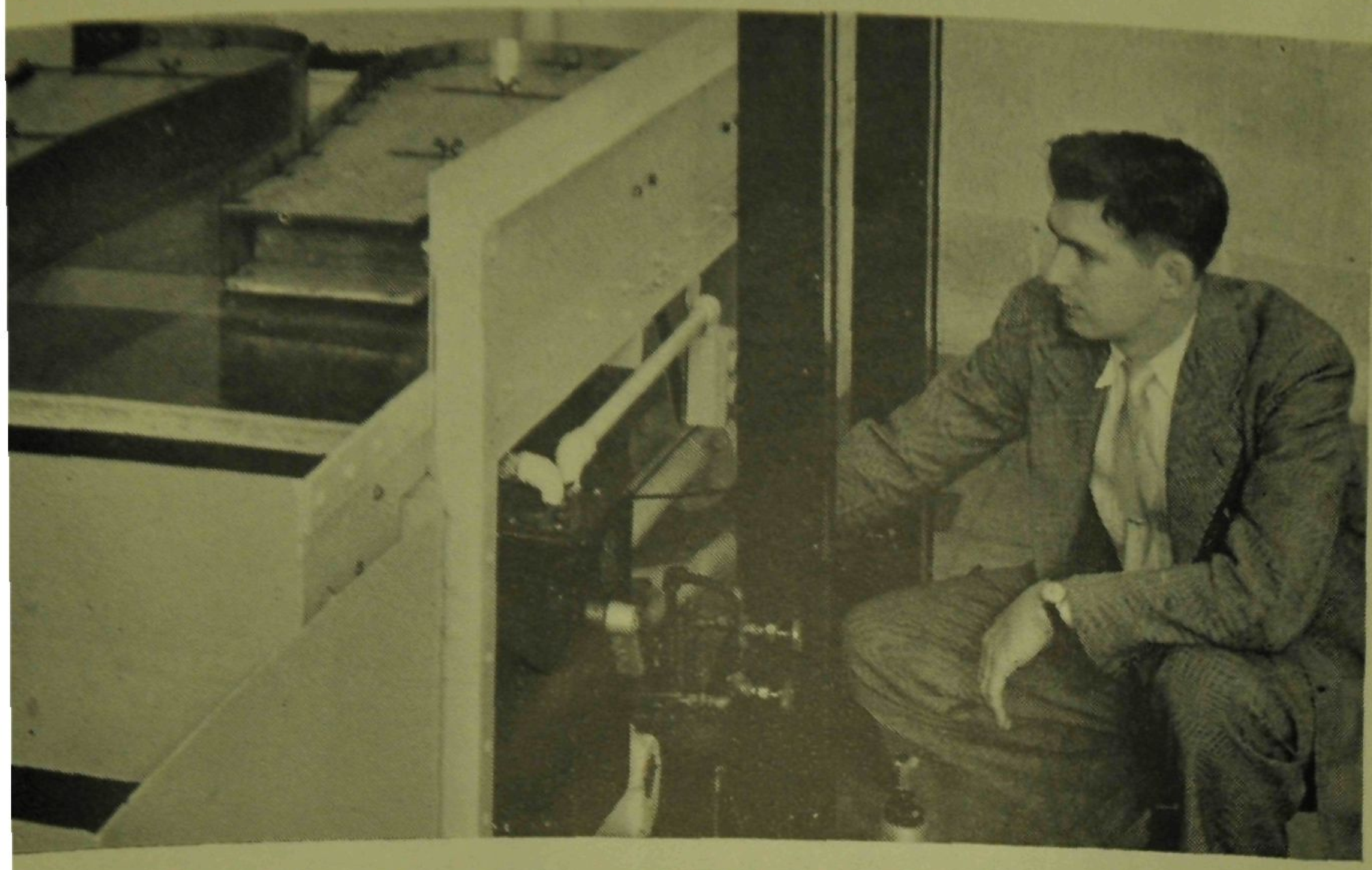
Since more than one-half of the male students in the University were enrolled in Engineering, the Engineering Hall was constructed in 1893. The Department occupied portions of the third floor of this building. Also during 1893, Professor L. P. Breckenridge, then head of the Department, gathered all the available equipment—two small engines made by Professor Robinson, a pump, some tanks and scales—placed them in two rooms on the ground floor of the present Harker Hall, and started power laboratory practice with one senior student. Thus, the equipment of the Department was arranged into three categories—class and drawing room work, power laboratory practice, and shop practice.

YEARS OF EXPANSION 1895-1944

In 1895, Machinery Hall, a one-story brick structure, 50 feet by 250 feet, was constructed. The Machine Shop was moved to this building and the power laboratory was moved to the Mechanical Engineering Building and Drill Hall. Then, in 1905, the first unit of the Mechanical Engineering Laboratory, a building 80 feet by 182 feet, was constructed and the power laboratory equipment (still in use) was moved to this building. From 1906 to 1916 a north wing 40 feet by 120 feet and a south wing 32 feet by 90 feet were added to the Mechanical Engineering Laboratory for use by other Departments of Engineering. But, in 1916, the M. E. Department occupied the entire space. The power laboratory was remodelled by removing the floor and constructing a new basement floor four feet below the old floor level and a mezzanine floor six feet above the old floor line. This arrangement in effect made the laboratory into a two-story affair.

In 1921 the Department took over the first and second floors of the Transportation Building for offices, classrooms, and drafting rooms, and in 1941 took over the entire second floor.

Thus in 1944, the Department had the total facilities consisting of the Machine Tool Laboratory, the Mechanical Engineering Laboratory, a portion of the Wood Shop and a large part of the first two floors of the Transportation Building.



Water Table To Give Analogy Of Compressible Flow

PRESENT ERA 1944 TO DATE

In 1949, the Mechanical Engineering Building at Green and Mathews street was completed. With the occupation of this building, the space in the Transportation Building and Machine Tool Laboratory was released to other Departments of Engineering.

This is the story, then, of how the Department of Mechanical Engineering began from a modest start with one professor and a converted mule stable for a machine shop and has grown to the position in which the staff numbers about one hundred.

CURRICULA

Not only has the Department expanded physically but it has also made available many optional course sequences in the M. E. curriculum. This variety permits the student to place emphasis on any one of the following phases: Heat power, machine design, production, research, air conditioning and refrigeration, petroleum production, and railway motive power. In addition to these special options, a general option is also provided which permits the student to select twenty-four semester hours of either technical work cutting across the special options, or in general education, commerce, social science, literature, and humanities. But, no matter which of the optional curricula the student chooses, he will be required throughout the four years to obtain training in the basic courses in science, mathematics, mechanics and engineering fundamentals.

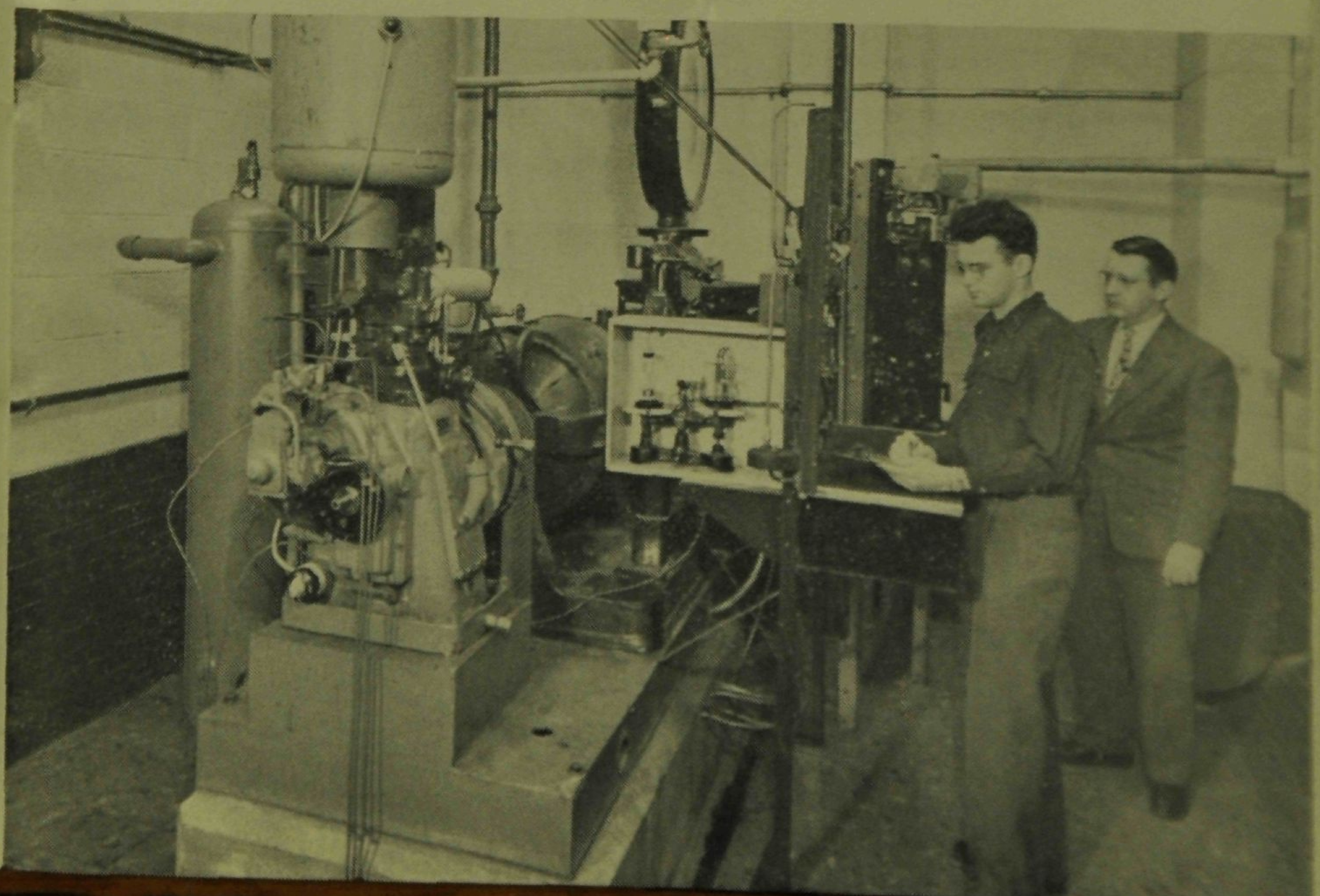
RESEARCH

Teaching and research are intimately related in the Department of Mechanical Engineering. Members of the instructional staff are encouraged to do research and members of the research staff are encouraged to do some teaching. Advanced undergraduate and graduate students participate in limited phases of research programs under the direct supervision of members of the instructional staff and responsible investigators. In addition to enhancing engineering knowledge it is intended that research stimulate engineering education. Research and education cannot be set apart.

The need for research was recognized by the Board of Trustees in 1903 when by formal action it created the Engineering Experiment Station, the first of its kind in existence.

More than fifty per cent of the cost of research in the Department is paid by sponsors outside of the University, with the remainder coming from State Appropriations. In general, only those projects which promise to add to the knowledge in specified areas of mechanical engineering are undertaken. The areas have included Properties of Steam, Air, and Ammonia; Combustion; Explosive Reactions; Flow of Fuids; Bonding Clays, Molding Sands and Core Oils; Drilling and Machining of Metals; Spur Gears; Friction and Lubrication; Heat Transfer; Summer Air Conditioning; Warm Air, Steam and Hot Water Heating; and Man's Physiologic Adjustment to Atmospheric Environment.

Research On Single Cylinder Diesel Engine



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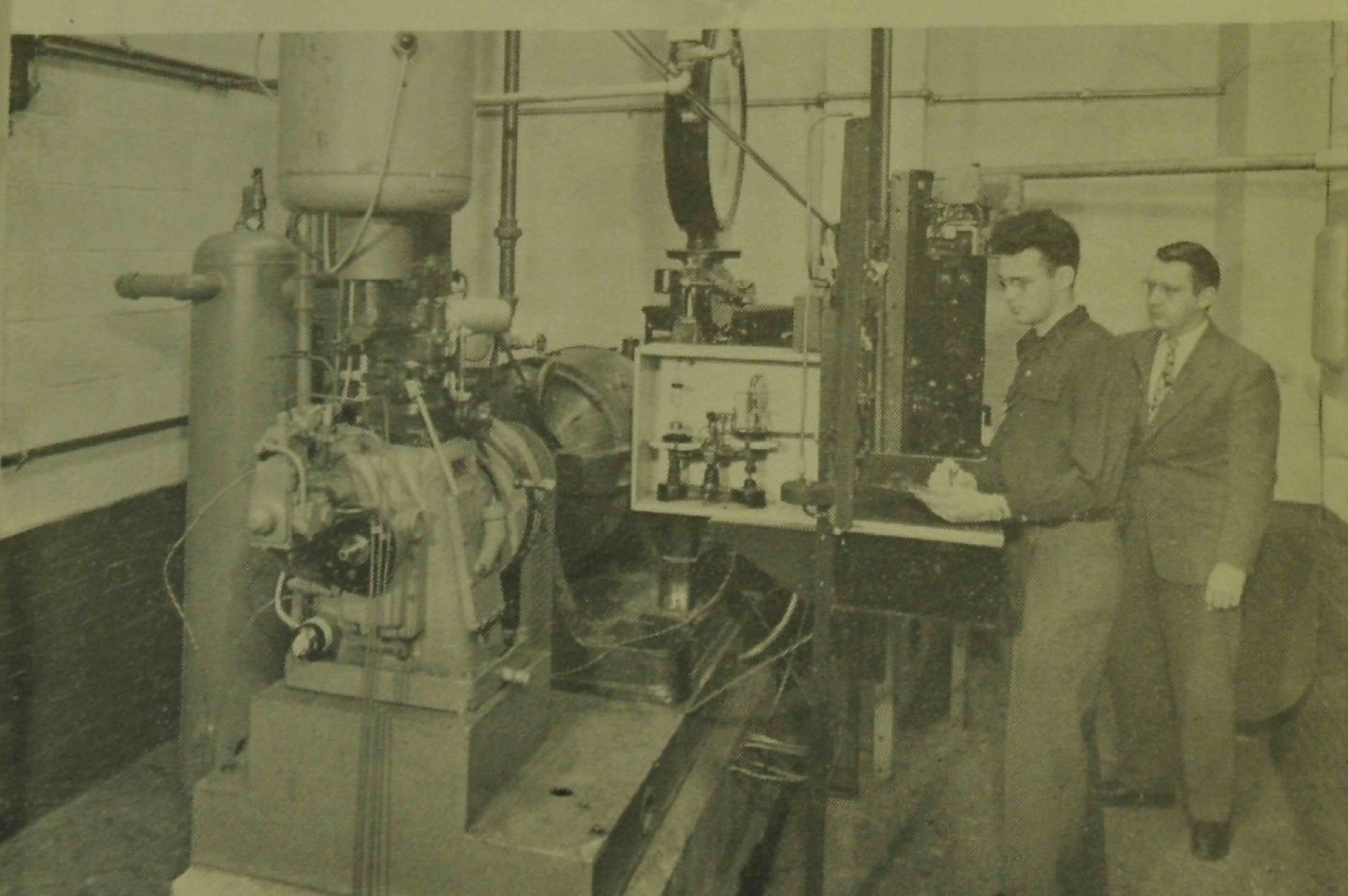
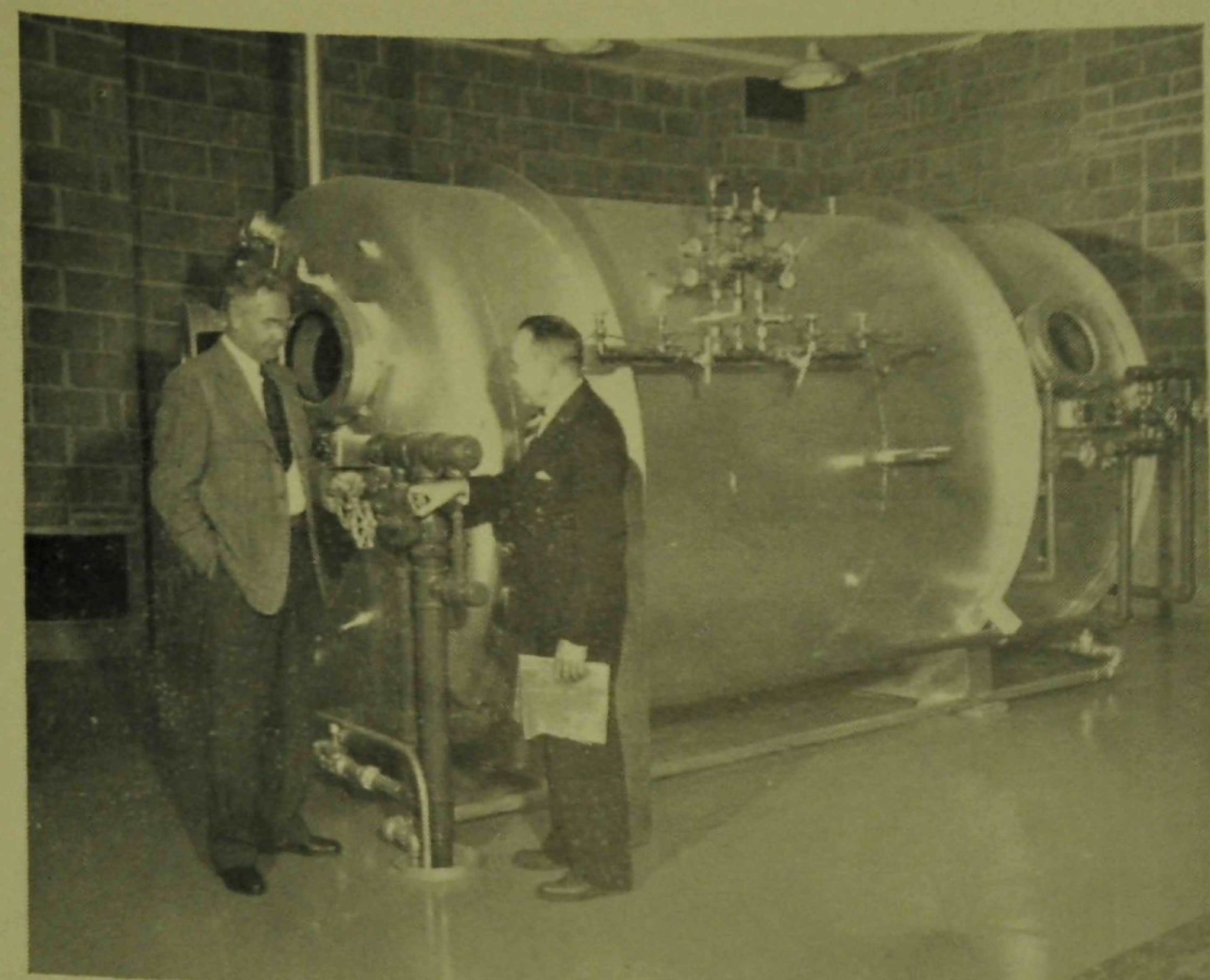




Low Pressure Chamber For Controlling Environmental Factors

As an outgrowth of cooperation between the Department of Mechanical Engineering and the Department of Medicine on research on man's physiologic adjustment to atmospheric environment, a unique plan for the acquisition and operation of extensive research laboratories on a semi-service basis has been developed. Animal, plant and human life are affected by environmental factors, such as temperature, humidity, pressure, air motion, air cleanliness, radiation, noise, light, and vibration. Physical facilities to accomplish control of these factors over wide ranges are costly to build and to operate. They can only be justified if they are in use a large proportion of the time and if they meet the needs of a number of departments or divisions.

As a result, a small physical environment laboratory has been set up in the Mechanical Engineering Laboratory Building. Here physical facilities are provided for the control of the temperature, humidity, pressure, cleanliness and motion of air over ranges sufficient to produce physiologic stress in human subjects. These facilities are available on a service basis to any department. They have already been used by the Departments of Physiology and Psychology, the Physical Fitness Laboratories and the Institute of Aviation. Similar facilities on a more extensive scale have been set up at the University's College of Medicine in Chicago.

All of these activities have demonstrated the need for and the advantage of research teams made up of persons trained and experienced in the biological and technological sciences and professions.

POWER LABORATORY

Power Laboratory (Located in the Mechanical Engineering Laboratory)—This laboratory provides space for the stationary steam equipment, some internal combustion engine equipment as well as heating, ventilating, air conditioning, refrigeration, air compression, pumping and other power equipment. Junior and senior students use this laboratory for making performance tests and for verifying various thermodynamic processes discussed in the classroom.

The equipment in the steam power field includes an oil-fired boiler which will generate steam at 1500 pounds per square inch and 900 degrees F., a stoker-fired heating boiler, an educational unit consisting of two turbines that may be operated in either series or parallel connection to 220 volt a.c. generators, a 100 kw turbine, a 25 kw turbine, a 100 hp steam engine, and a 25 hp steam engine.

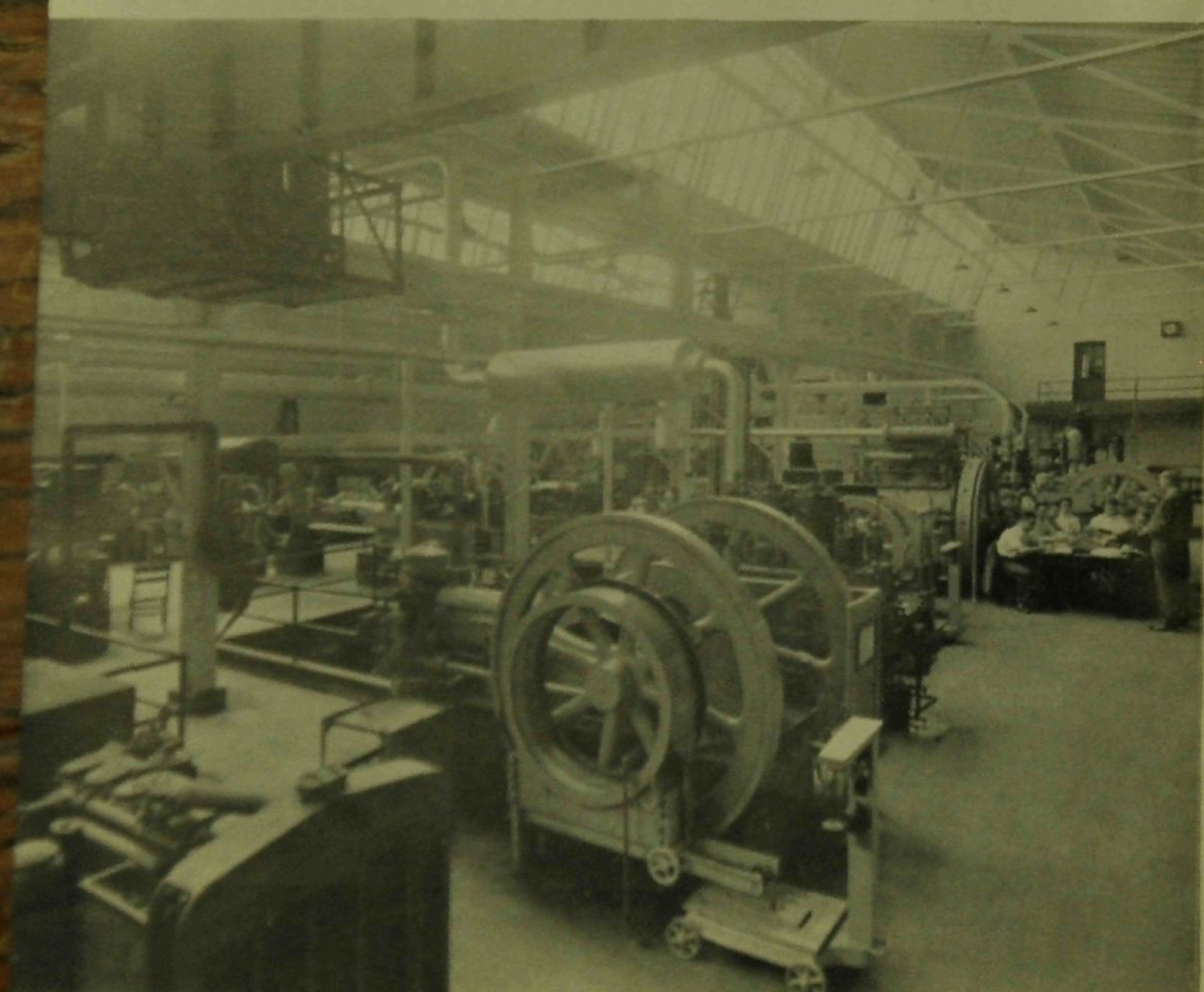
The internal combustion engines provided are two diesel engines, one of four-stroke and the other of two-stroke cycle; and two single-cylinder natural-gas engines.

The heating, ventilating, and air-conditioning equipment consists of an air-conditioning unit completely covering the methods of air treatment such as heating, humidification, cooling and dehumidification.

The refrigeration equipment consists of a steam-driven 10-ton ammonia machine, an electric-motor-driven 7.5 ton ammonia machine, and a 1-ton steam jet refrigerator.

Other equipment available includes three air compressors, a steam-driven duplex pump, two centrifugal fans, a brake tester, a belt tester, a speed reducer, and all the instruments necessary to conduct tests on the foregoing pieces of apparatus.

Power Laboratory



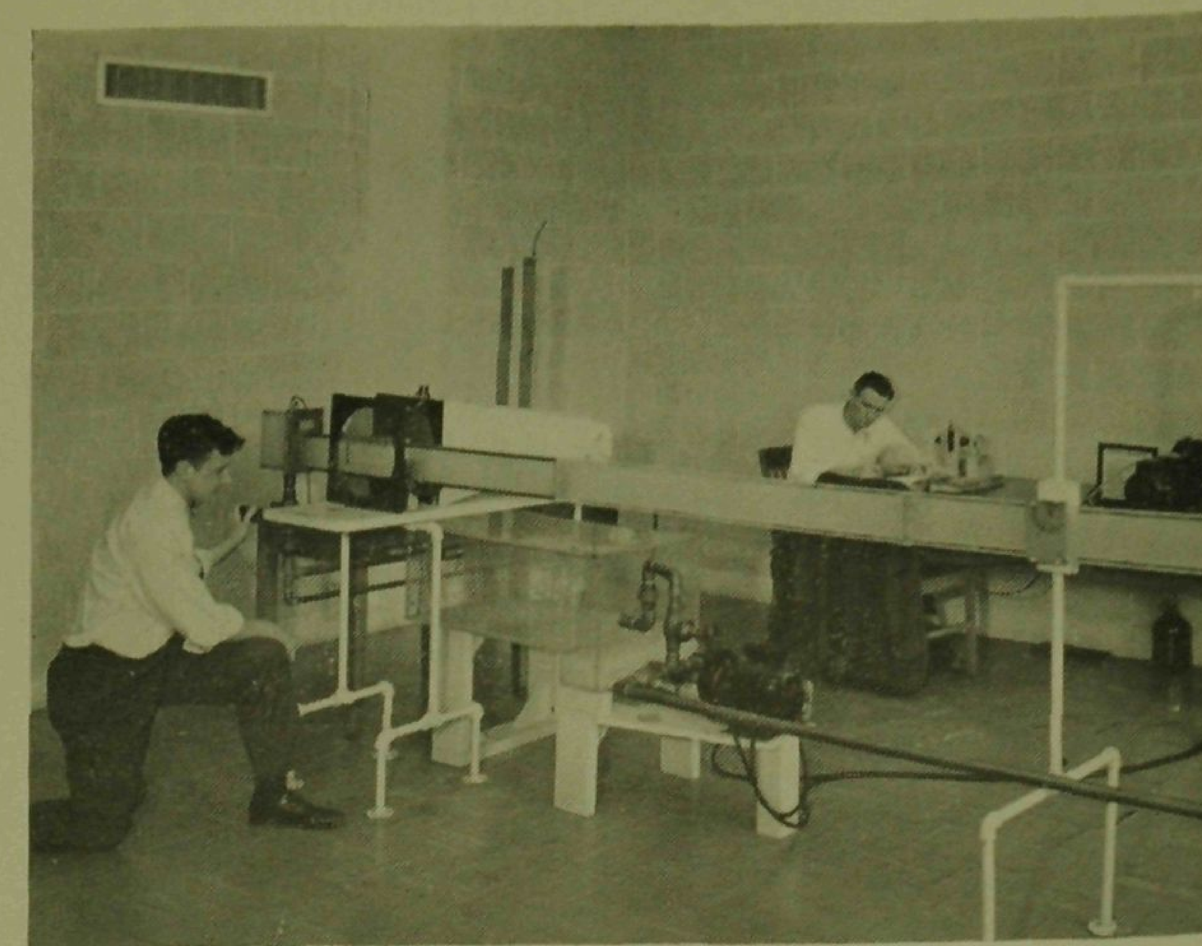


Photo-Viscous Method of Flow Analysis

SPECIAL LABORATORIES

Certain phases of Mechanical Engineering, although closely associated with heat treatment of metals, metal processing, internal combustion engines, and steam power equipment, are of such importance that studies may be made upon them individually rather than as a part of a large piece of equipment. Special laboratories for studies of problems in Instruments and Controls, Fuels and Lubricants, Heat Transfer and Thermodynamics have been provided.

All special laboratories serve a two-fold purpose in that they provide space for equipment upon which research may be accomplished both at the graduate and undergraduate level, and also provide space for equipment upon which demonstration of basic principles may be portrayed.

Room 35—Instruments and Controls Laboratory—Many manufacturing processes of today are carried on automatically by controls. Thus for any process it is necessary to know limits of stability and accuracy of a process and the effect of one variable upon another. Senior and graduate students use this laboratory for the study of basic control elements, properties of mechanical processes, and the variables which affect the control of these processes.

In addition to the basic instruments for measuring pressure, temperature, flow, velocity, and humidity, there are control arrangements for demonstrating flow and liquid level control and thermal control involving time lag and capacity effects.

Room 43—Fuels and Lubricants—In order to determine thermal efficiencies of heat-power equipment, the heating value of the fuel must be known. Also the proper functioning of such equipment may depend upon the selection of a lubricant which will not break down during operation.

Junior students use the equipment for determining the calorific values of gaseous, liquid, and solid fuels, as well as the physical properties of importance in the performance, identification, and specification of fuels and lubricants.

Room 45—Heat Transfer Laboratory—Economic considerations in heat-power equipment dictate the minimum amount of material for the most effective transfer of energy from one substance to another. Not only is a knowledge of physical properties of the fluid required, but also an appreciation of the methods and magnitudes of heat transfer. Seniors and graduate students use the laboratory to confirm existing data on heat transfer and to extend the field of knowledge.

Equipment is provided for determining thermal conductivities, thermal emissivities, configuration factors, and other heat transfer phenomena.

Room 51—Thermodynamics Research Laboratory—A knowledge of energy transformations from heat to work as well as thermal and physical properties of solid and fluid media are necessary for the proper design of heat-power equipment. Seniors and graduate students are provided with facilities for investigating problems involving properties of fluid media and energy transformation.

In addition to the basic instruments necessary for operation of the laboratory, a water table has been constructed which will give the analogy of a two dimensional compressible flow of a gas with a "K" value of 2 by the motion of water on a level plane with a free surface due to gravitation. Also, there is apparatus constructed which applies a photo-viscous method for analyzing fluid flow. This method using polarized light enables one to visualize areas of constant shear in a field of moving liquid which is a colloidal solution of Bentonite clay in water.

Research Residences For Heating and Air Conditioning

LABORATORIES AND EQUIPMENT

METAL PROCESSING LABORATORY

Cutting and forming of metal parts require a knowledge of various types of machine tools, jigs and fixtures, dies, and the cutting characteristics of metals. Sophomore, junior, and senior students use this laboratory to acquire knowledge and experience in the application of the art of metal processing.

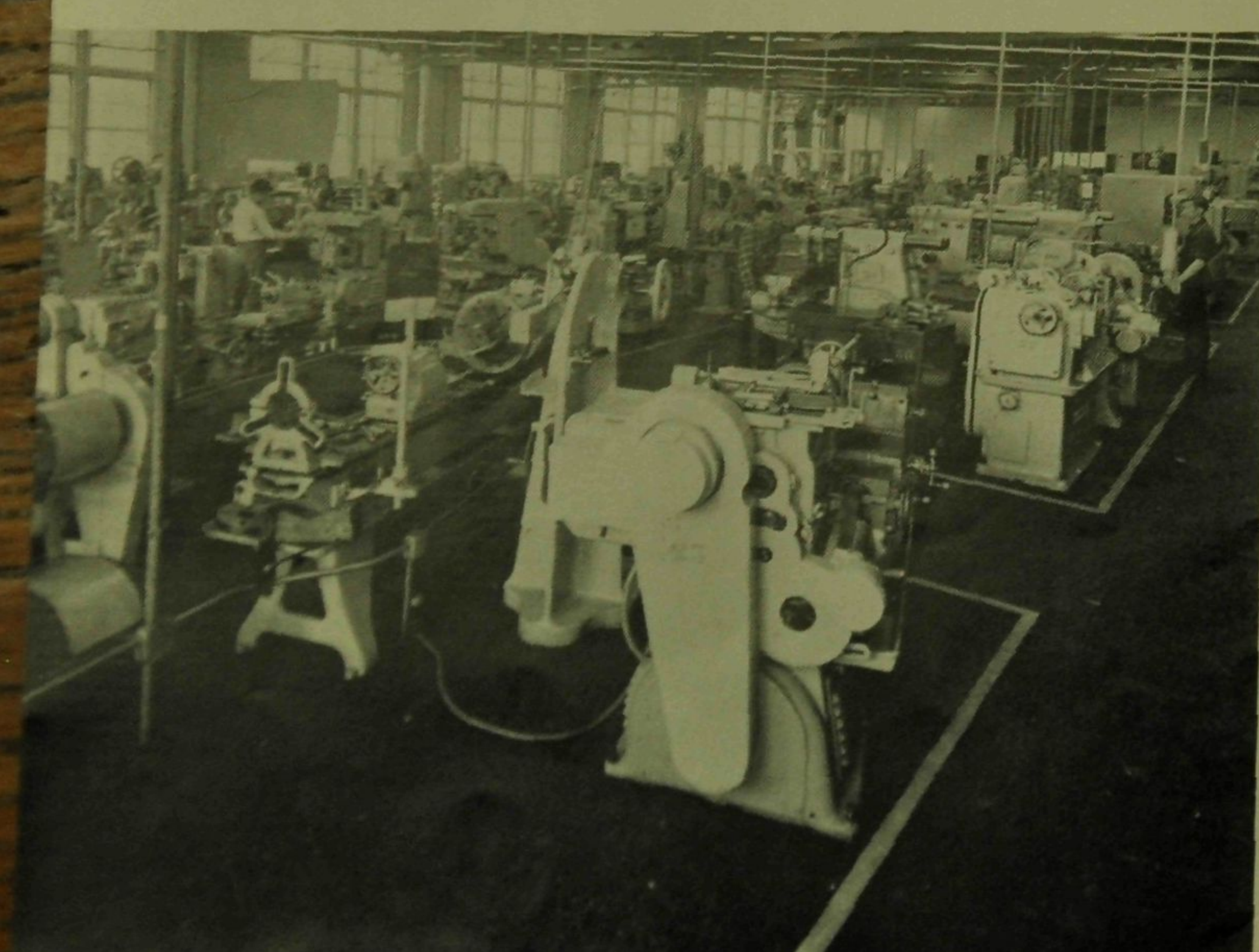
Room 217—The MACHINE TOOL LABORATORY contains over 100 machine tools for the machining of metal parts for several standard products, one of which is a half-horse power, air cooled gasoline engine. All cast iron, aluminum, and bronze parts are produced by students in the materials casting laboratory. Several machine tools are equipped with dynamometers to provide data on the forces required to cut various metals.

Room 215 and 216—The INSPECTION ROOM and TOOL ROOM contains tools and gages for the inspection of machined parts. The Inspection room serves as a dispatching center for assignment of work to students, and the distribution of tools and instruction cards for the various operations.

Room 218—The LECTURE ROOM with seating capacity for 100 students is used for demonstrating the various types of machine tools. This room is equipped with a turntable and overhead track which enables any piece of equipment in the Machine Tool Laboratory to be brought into the room for demonstration purposes.

Room 221—WELDING LABORATORY—Many manufacturing processes require that metals be joined by welding. Senior students use this laboratory to gain experience in recognizing a good weld and noting the symptoms that indicate the possibility of a bad weld. The student also obtains a good idea of the capabilities and limitations of welding as a joining process.

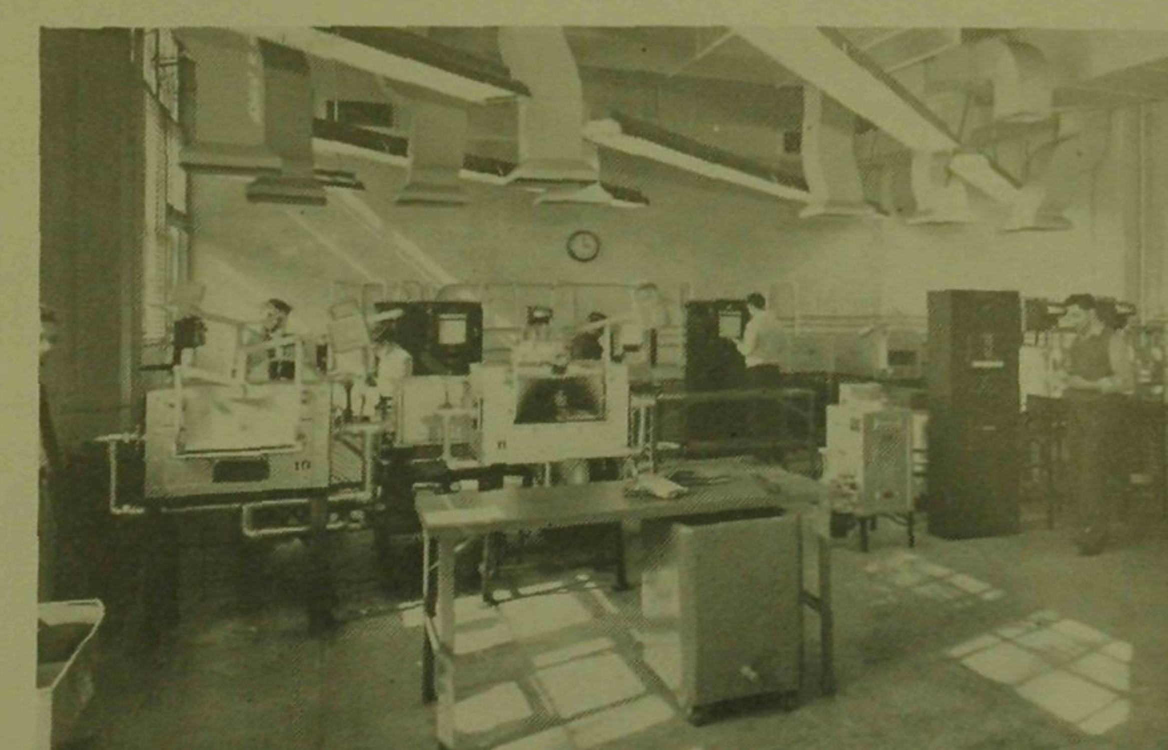
Machine Tool Laboratory



The laboratory provides facilities for arc-welding, resistance welding, oxy-acetylene welding and flame cutting. Equipment is available for making tensile tests, guided bend tests and free bend tests on a finished weld.

Room 221b—METAL CUTTING LABORATORY—Although metal machining operations have been practiced for centuries, it is only recently that such basic factors as chip formation, cutting temperatures, and chip friction have been investigated. Graduate students use the facilities for instruction and research in metal cutting problems.

This laboratory contains basic machine tools equipped with cutting force dynamometers, and a machine for the measurement of the hardness of tools or materials at elevated temperatures.



HEAT TREATMENT OF METALS LABORATORY

The design of machine parts and the correlation with their processing require a knowledge of metals with respect to properties, heat treatment, and the effects of such treatment upon the physical properties. Junior and senior students use the laboratory to obtain experience in the heat treatment processes for metals.

Room 114—The FURNACE ROOM contains such basic equipment as gas-furnaces, electric-furnaces, a high-frequency induction unit, and a gas-carburizing furnace.

Room 120—The MICROSCOPE ROOM contains apparatus for the polishing and etching of metals, together with microscopes for studying the structure of metals.

Room 115—The INSTRUMENT ROOM contains basic instruments for physical tests of specimens, such as a tensile testing machine, hardness testing machine, and hardenability testing equipment.

SAND TESTING LABORATORY AND CORE ROOM (located in the Wood Shop)—The type and shape of sand grain for molding sand and core sand used for castings has an effect upon the quality of the finished castings. Sophomore students use this laboratory to gain experience in determining the properties of molding sand and core sand.

The sand testing laboratory contains a universal sand-testing machine, a sand specimen rammer, a moisture teller, a defloculator, a dispatch core oven and sieves for determining sand size.

The core room contains a sand muller, core boxes, core making machines, furnaces for baking cores, and cleaning equipment for castings.

METALS CASTING AND PATTERN LABORATORY (located in the Wood Shop)—In order to produce a satisfactory casting, the design of patterns and the correlation between the pattern and the casting must be studied. Sophomore students use this laboratory for studying and applying the methods of melting, handling, and pouring molten metal, both ferrous and non-ferrous. In addition the student studies production methods and the limitations of material handling with respect to cleaning, inspecting, and processing for storage or customer use.

This laboratory contains various types of molding machines, a cupola, non-ferrous metal furnaces and equipment for pouring of molten metal. Also, there are a number of displays showing patterns, and castings for use by the students who are studying pattern design.

Room 135—TOOL DESIGN LABORATORY—Before a product may be manufactured in quantity, plans must be made with respect to the manufacturing process, the tools to be used, the method of handling the materials, and the arrangement of the machines and equipment. Senior students use this laboratory to work out projects in the manufacture of a specified product.

The laboratory is equipped with a selected group of jigs, fixtures, dies, and other basic production tools that illustrate the principles of "tooling" for a job. Also a model of an industrial plant has been constructed with model machines and equipment for visual studies of the problems of industrial planning.

Room 235—MOTION AND TIME STUDY LABORATORY—The industrial engineer is constantly confronted with the problem of determining the "best" way of applying human effort to do a job and the standard time which should be allowed. Junior and senior students use this laboratory to obtain experience in applying the principles of motion and time study to certain factory production problems assigned to them.

The laboratory contains projection equipment, material bins of proper design to demonstrate good work-space layout, time study equipment and movie cameras to record data for micromotion study.

Machine Design

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Room 243—PRECISION MEASUREMENTS AND GAGE LABORATORY—In any manufacturing process, it is necessary that a representative sample of the finished product be inspected to determine if it is acceptable. Senior students use this laboratory to study the basic principles of precision measurement and to operate some of the various measuring instruments used in production.

The laboratory contains instruments that will obtain measurements by mechanical, electrical, optical, or pneumatic methods.

Machine Design

Rooms 332, 335, 353, 363—MACHINE DESIGN DRAFTING ROOMS—The design of machinery requires a clear understanding and working knowledge of engineering mechanics. Static forces, masses moving with constrained motions, velocities and accelerations must be studied in relation to each other. By means of skeleton outlines, line drawings, vectorial representation, and graphical techniques, the student learns to express these basic relationships on the drafting board and to apply them to the design of machine elements.

Room 249—The MACHINE DESIGN LABORATORY contains equipment that serves to illustrate and complement the subject matter included in machine design texts. Here the students learn by demonstration the importance and effects of properties of material, types of loading, and existing stress distributions on the design of machine parts. Photo-elastic apparatus as well as other facilities are used to aid the student in visualizing the various phenomena encountered in machine parts under simulated operating conditions.

Room 344—The MODEL ROOM contains actual machine parts, assembled mechanisms, and working models that are discussed and designed in the classroom. The exhibit enables the students to better understand and appreciate the derived equations, design procedures, and experience factors used in machine design work.

INTERNAL COMBUSTION ENGINE LABORATORY

One important phase of mechanical engineering deals with power obtained from internal combustion engines. In the selection, design and development of these engines, it is necessary to determine their performance with respect to such items as size, weight, speed, power output, and efficiency.

Performance testing of gasoline and Diesel engines is done in this laboratory by senior students. Facilities are available for research in the fields of engine testing, fuels, and lubricants.

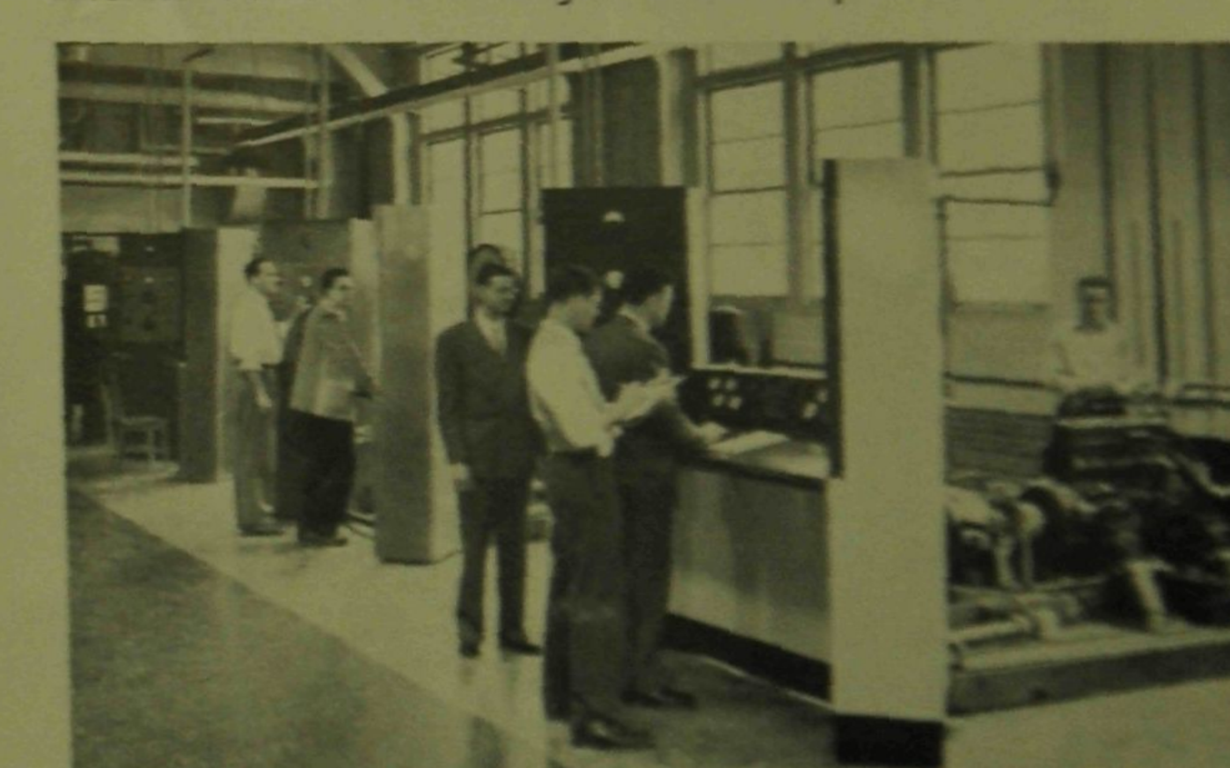
Room 101—The MAIN LABORATORY contains five gasoline and diesel engines connected to dynamometers for purposes of performance testing. In addition, a transmission type dynamometer is provided for driving various pieces of test equipment such as superchargers, blowers, etc. A small diesel engine with a brake is used for research purposes. A large Diesel engine-generator set is used to supply large amounts of electrical power to the laboratory.

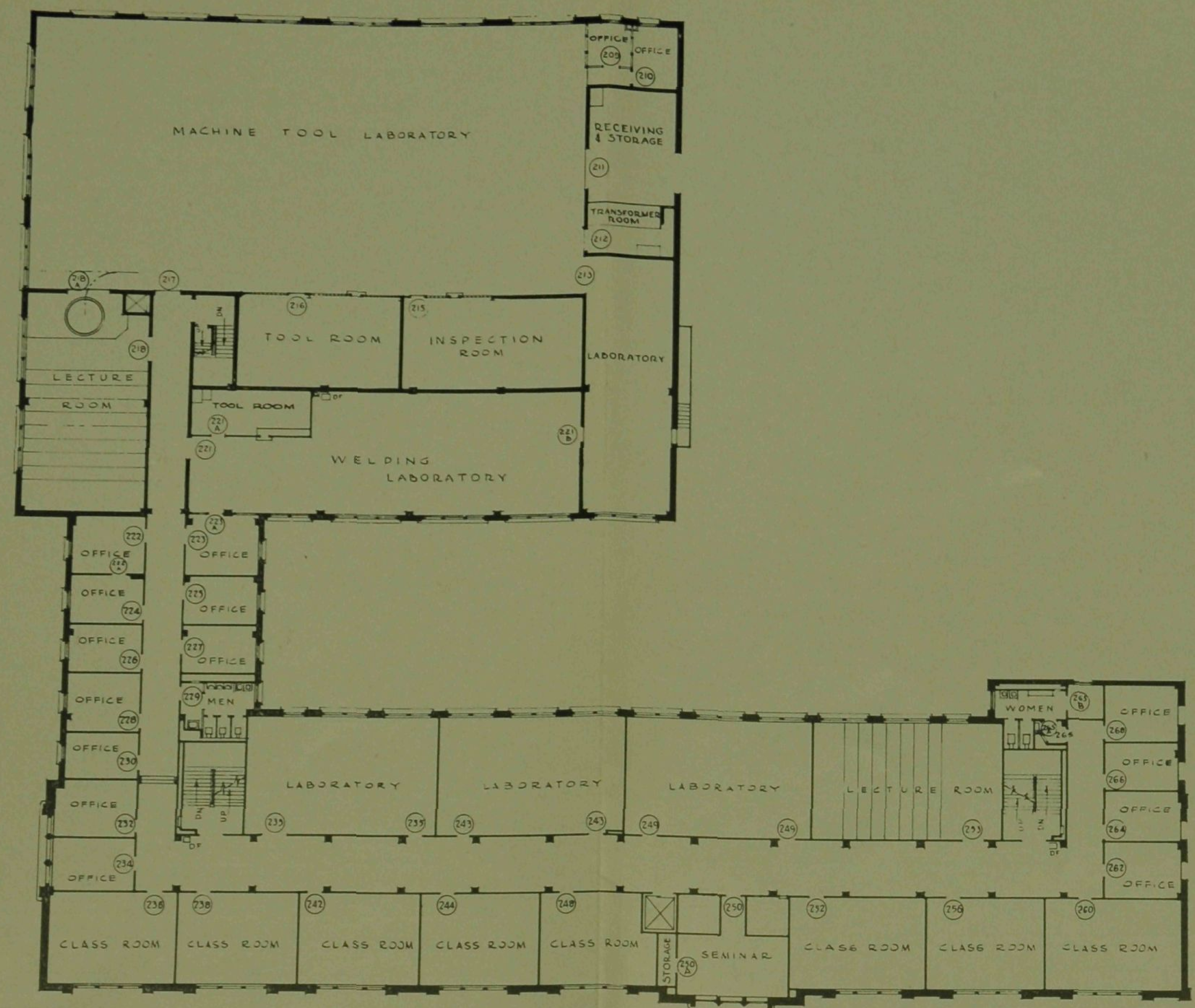
Room 105—The CFR DIESEL ENGINE ROOM contains a single-cylinder supercharged diesel engine so arranged that the compression ratio may be changed while in operation. The unit is used for fuel testing and the determination of the effects due to changing compression ratio and supercharging.

Room 106—The CFR GASOLINE ENGINE ROOM contains a single cylinder supercharged gasoline engine so arranged that the compression may be changed while in operation. The unit is used for the same purposes as the CFR Diesel engine.

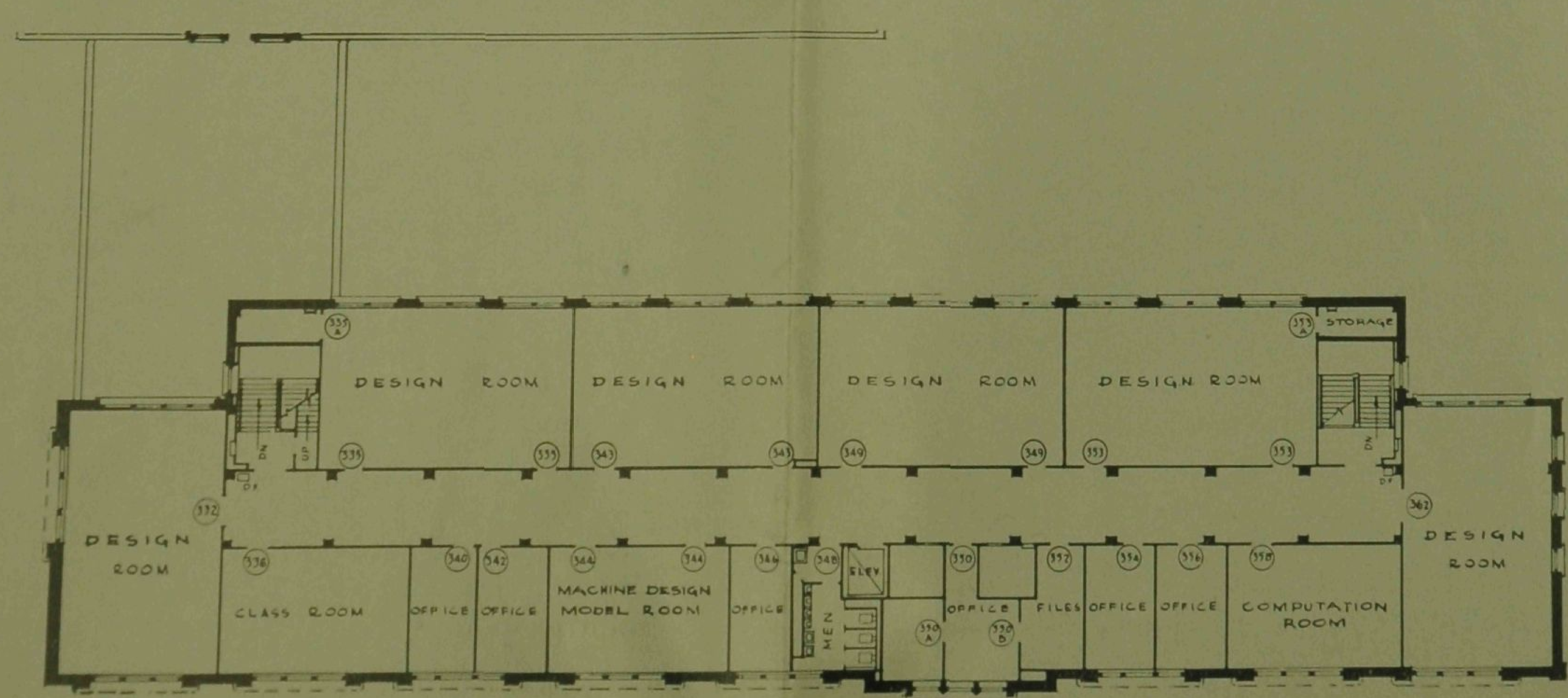
Room 107—The FULL SCALE ENGINE TESTING ROOM contains an air-cooled aircraft engine connected to a dynamometer. The unit is so arranged that intake and exhaust pressures may be changed to simulate altitude conditions of from 1000 feet below sea level to 20,000 feet above sea level; and the temperature may be varied from −40° F. to 150° F.

Internal Combustion — Engine Laboratory





Second Floor Plan



Third Floor Plan

SUMMARY OF FACILITIES IN THE MECHANICAL ENGINEERING BUILDING

The Mechanical Engineering Building has 87,773 square feet of usable floor space. The area is utilized in the following manner:

Use	*Sq. Ft.*	*%*
13 Classrooms	9,260	10.6
5 Lecture Rooms	4,284	4.9
16 Laboratories	29,316	33.4
7 Design Rooms	7,151	8.2
4 Seminar Rooms	1,006	1.2
2 Computation Rooms	806	.9
46 Offices	7,594	8.6
Student Lounge	1,099	1.2
Secretary	627	.7
Lavatories	3,029	3.5
Files	381	.4
Corridors	13,018	14.8
Stairs	3,055	3.5
Janitor Rooms	290	.3
Storage	2,529	2.9
Mechanical Equipment and Physical Plant	4,328	4.9
Total	87,773	100.0

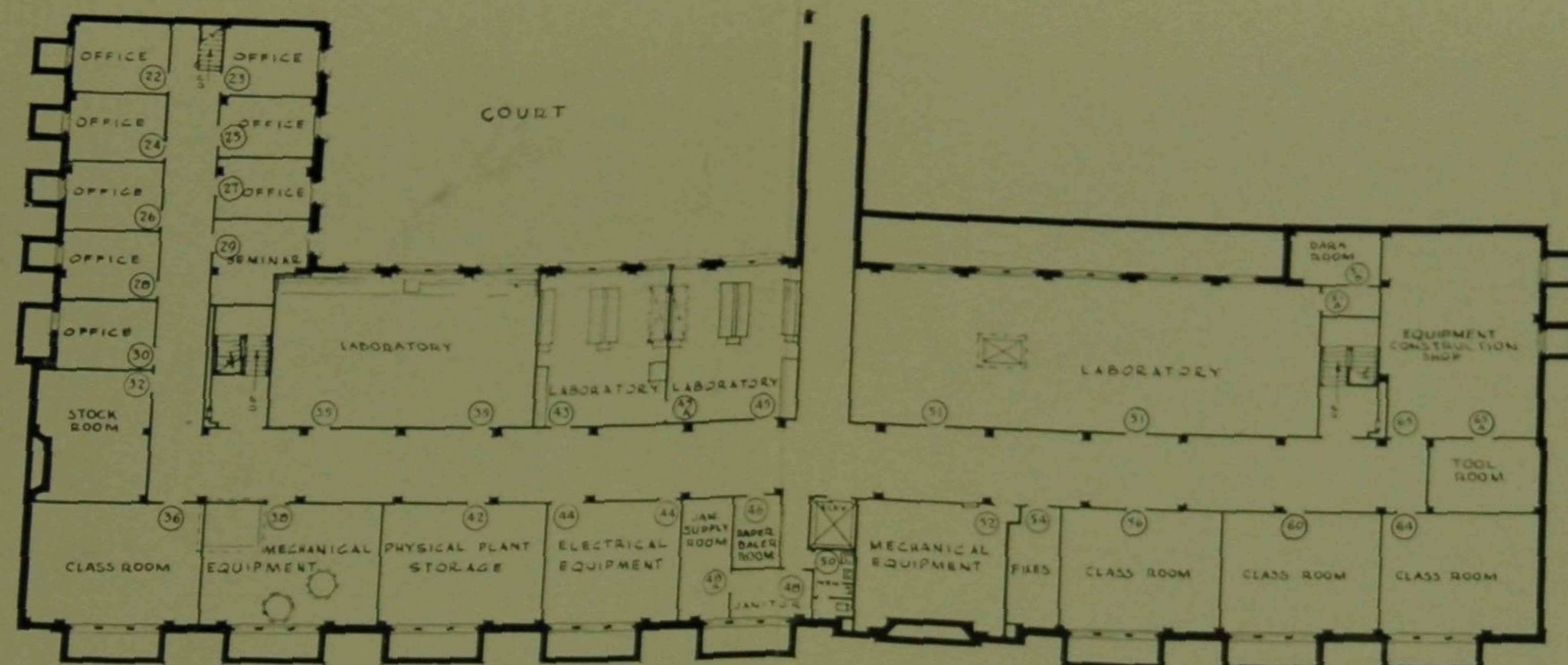
Net 61143

Bldg. and Equipment cost about ... Built '47-'49. Occupied 1950.

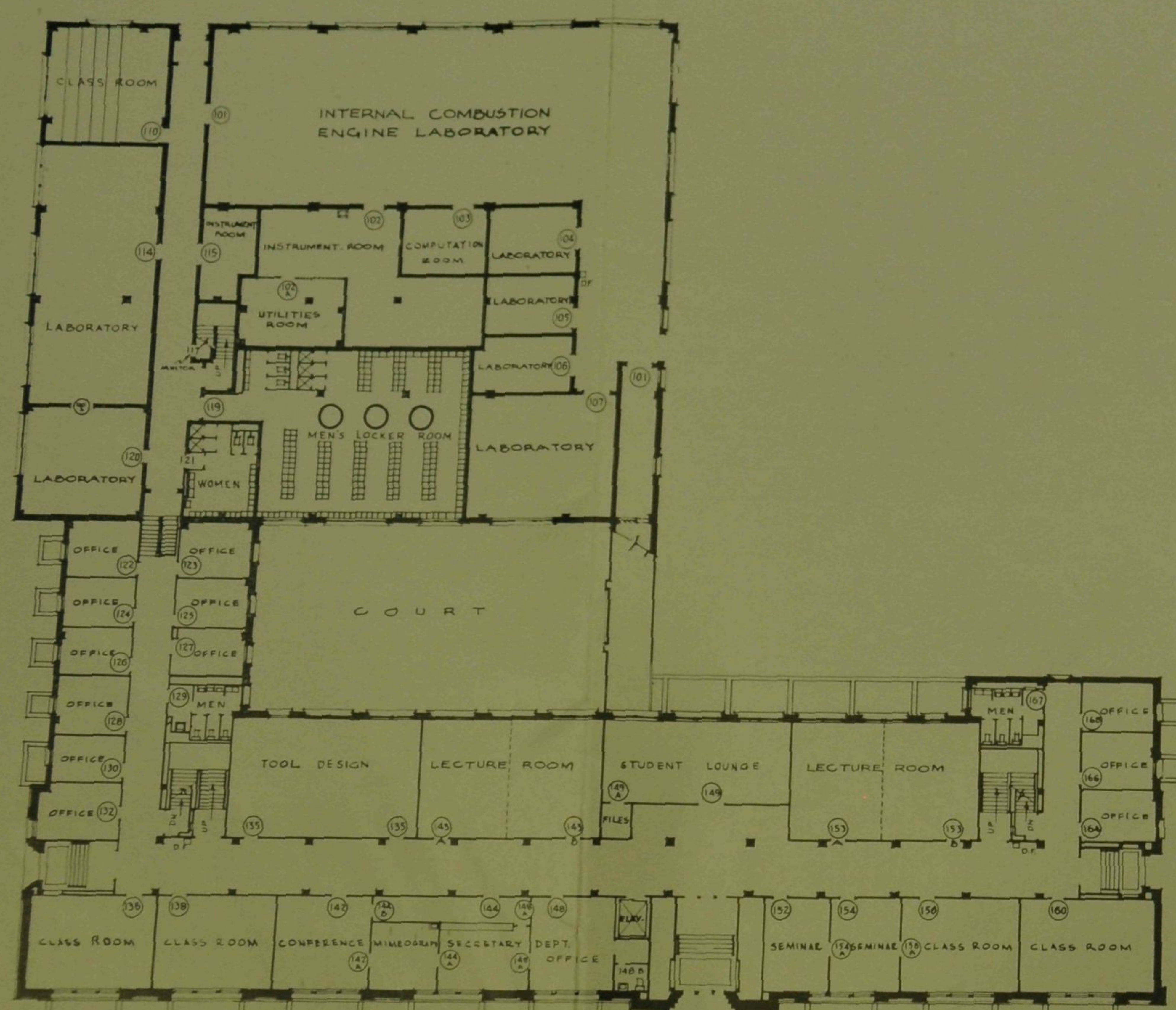
SAND TESTING LABORATORY AND CORE ROOM (located in the

Room 243—PRECISION MEASUREMENTS AND GAGE LABORA-

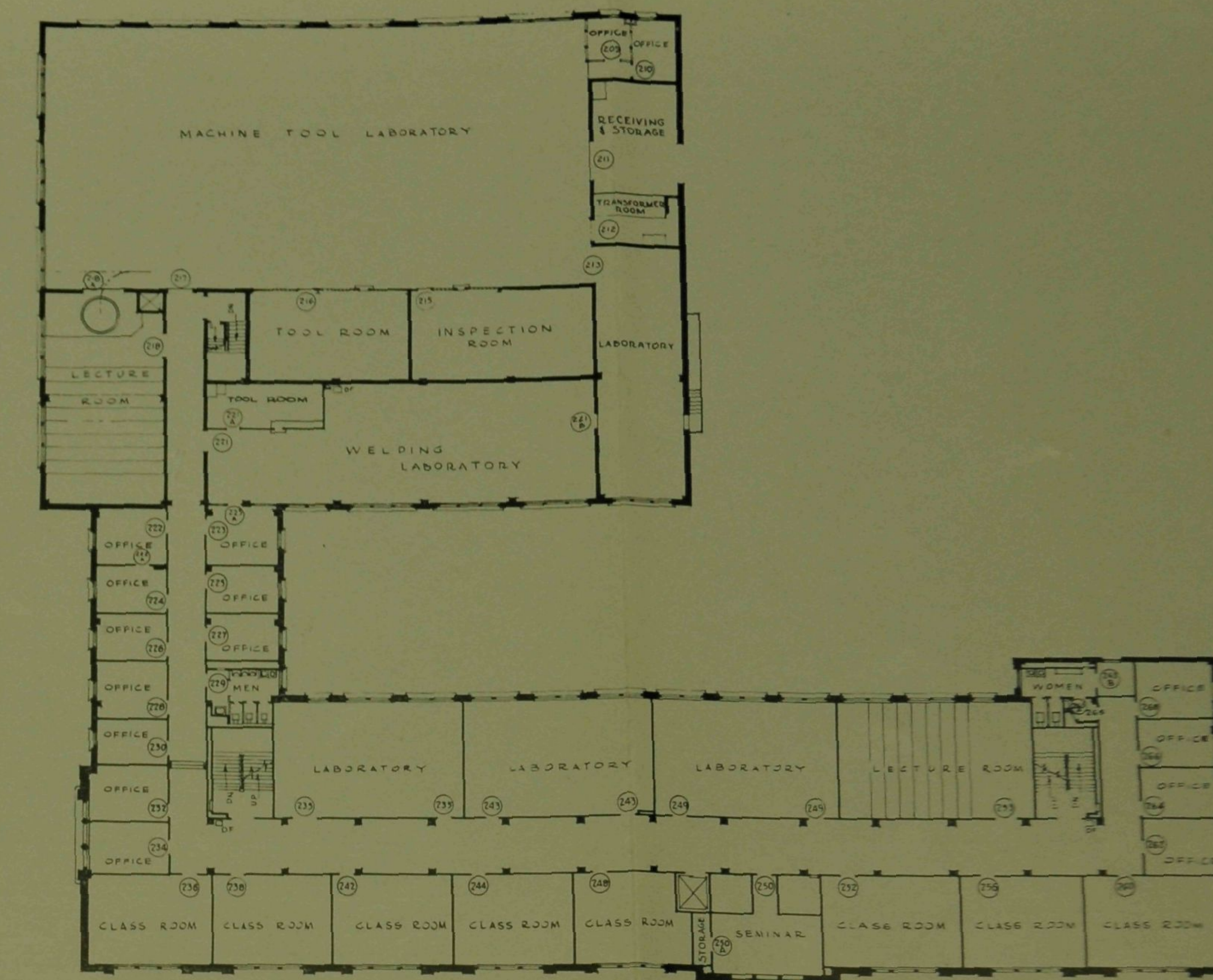
INTERNAL COMBUSTION ENGINE LABORATORY



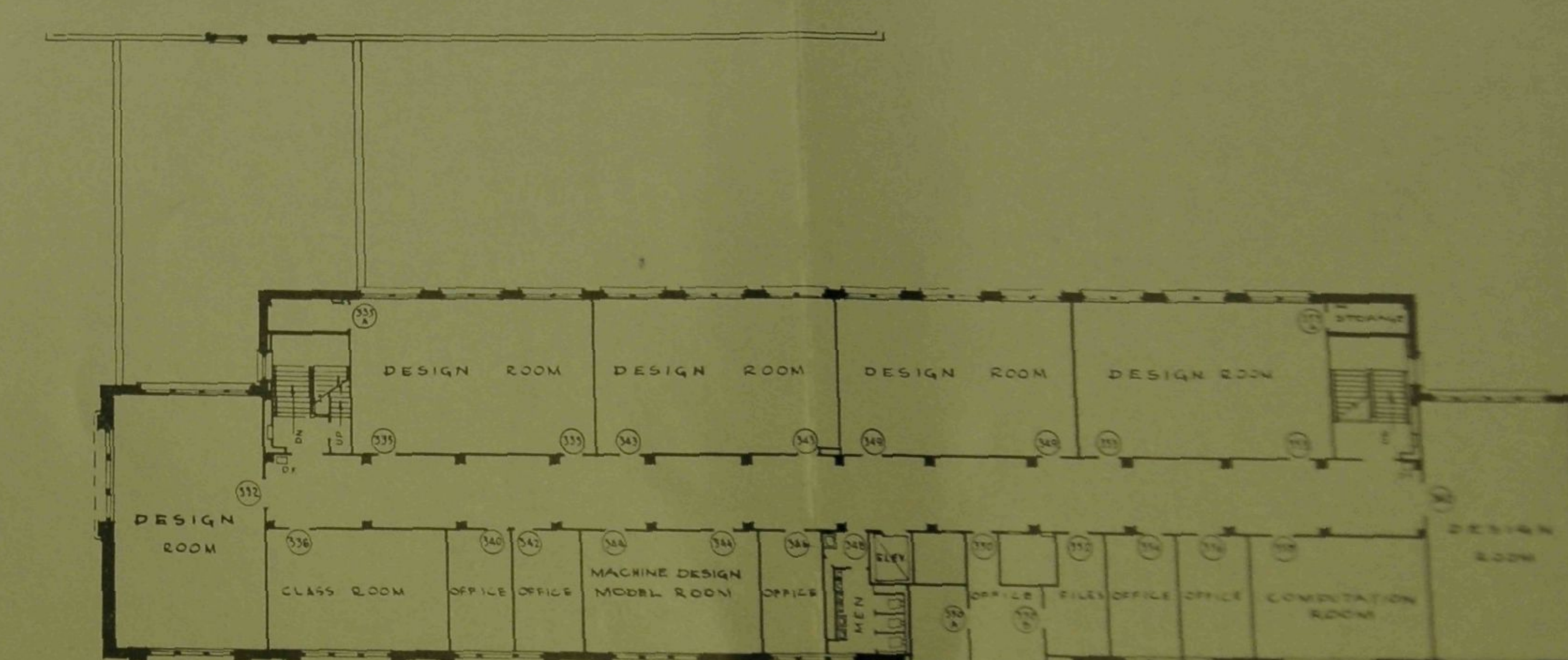
Ground Floor Plan



First Floor Plan



Second Floor Plan



Third Floor Plan

LABORATORIES AND EQUIPMENT

METAL PROCESSING LABORATORY

of the capabilities and limitations of welding as a joining process.

Sand Testing Laboratory and Core Room (located in the Wood Shop)—The type and shape of

Room 243—Precision Mea